REMARKS

Claims 10 to 25 are pending in the application, of which claims 20 to 25 are allowed, claims 10 to 19 are rejected and claims 13 and 14 are objected to.

Claim Objections

The Office has objected claims 13 and 14 as it is unclear what the "other" signal is referring to in claim 10. The applicant has amended claims 13 and 14 to clarify that the "other" signal refers to "<u>a signal selected from the group of signals not modified to generate said first modified signal consisting of said excitation signal and said reference signal</u>" so that both the excitation signal and the reference signal are modified rectangular wave signals with constant value sections and that the other signal are shortened by a predetermined second time interval during which such said second modified signal has different value from the constant value sections of said second modified signal. The applicant believes that new claims meet the formal requirements.

Claim Rejections – 35 USC § 103

The Office has quoted the statute from 35 USC 103(a), which is referenced herein. The Office has rejected claims 10 and 13, as being unpatentable over U.S. Pat. No. 5063937 issued to Ezenwa in view of U.S. Pat. No. 6320370 issued to Weggel. Applicant has carefully considered the Office rejections and respectfully disagrees.

According to the MPEP §2143.01, "[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either the references themselves or in the knowledge generally available to one of ordinary skill in the art." Thus, despite the recent ruling in *KSR Int'l Co. v. Teleflex, Inc.,* No. 04-1350 (U.S. Apr. 30, 2007), obviousness cannot be established by combining prior art to produce the claimed invention absent some reasoning supporting the combination. The mere fact that the prior art may be modified in the manner suggested by an examiner does not make the modification instantly obvious.

"...[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to

support the legal conclusion of obviousness. *See Lee*, 277 F.3d at 1343-46; *Rouffett*, 149 F.3d at 1355-59." *In re Kahn* (Fed. Cir. 2006, <u>04–1616</u>).

Therefore, in formulating a rejection under 35 U.S.C. 103(a) based upon a combination of prior art elements, it remains necessary to identify the reason why a person of ordinary skill in the art would have combined the prior art elements in the manner claimed. (*see* USPTO Memo May 30, 2007 from Margaret A. Focarino, Deputy Commissioner for Patent Operations)

A useful presentation for the proper standard for determining obviousness under 35 USC §103(a) can be illustrated as follows:

1. Determining the scope and contents of the prior art;
2. Ascertaining the differences between the prior art and the claims at issue;
3. Resolving the level of ordinary skill in the pertinent art; and
4. Considering objective evidence present in the application indicating obviousness or unobviousness.

The Office rejected Claims 10 and 13 under 35 USC 103(a) as being unpatentable over Ezenwa reference in view of Weggel reference. Applicant has carefully reviewed the cited references and respectfully disagrees.

The Office notes that the Ezenwa reference "teaches a method for measuring an electrical impedance of an object <u>using periodic non sine wave signals</u> as claimed by applicant <u>including applying an excitation signal to the object</u> and measuring a response to the excitation signal using synchronous demodulation. A reference signal drives the synchronous detector. The signals are square waves/rectangular waves with constant value sections (see columns 2, 4 and 5)."

The claim 10, as amended reads:

Claim 10 (Currently Amended): A method for measuring of an electrical <u>complex</u> impedance of an object using periodic ~~non~~ <u>non-</u>sine wave signals, the method comprising:

applying an excitation signal to the object; and

measuring a response signal from the object to the excitation signal using synchronous demodulation, ~~whereas~~ wherein both the excitation signal and a reference signal driving a synchronous detector are generated from a rectangular wave~~s,~~, and both the excitation signal and the reference signal~~s~~ ~~having~~ have constant value sections, and

generating a first modified signal by modifying either~~wherein~~ said excitation signal or said reference signal ~~is modified~~ so that constant value sections of said first modified signal are shortened by a predetermined first time interval, during which said first modified signal has different constant value from the constant value sections of said first modified signal.

Claim 10 has been amended to clarify the claimed language. The claimed invention provides that both the excitation signal and the reference signal are non-sine periodic signals and that non-sine periodic signal is introduced into the object. Consequently, also the response signal is a non-sine periodic signal. In Ezenwa, a square/rectangular signal is first generated only to generate a sine wave and then the sine wave is introduced into the object. In Ezenwa, sine wave is used for driving the synchronous detector.

Nothing in Ezenwa teaches or suggests introducing the square/rectangular wave into the object. In fact, Ezenwa goes all the way to transform the square/rectangular wave into a sine wave before introducing it into the object, using clipper circuits and tunable high-Q filter (column 2, lines 10 to 15, FIG. 1). It is apparent that according to Ezenwa's method, using square/rectangular wave would introduce huge measurement errors (due to higher harmonics) into the system. Thus, in fact Ezenwa teaches away from using square/rectangular waves.

Also, nothing in Ezenwa teaches or suggests using modified rectangular signals for suppressing higher harmonics. Instead, Ezenwa uses tunable high-Q filters. It is known in the art that tuning high-Q filters for required frequencies is time consuming, complex task and requires complex circuitry.

The Office notes that the Ezenwa reference "do not teach shortening the signals constant value sections by a predetermined first interval.", but the office notes that 'Weggel reference "teaches a method for measuring current through an object/load by pulse width modulation of signals, which varies the width of a train of square waves (column 5, lines 6-10). It would have been obvious in view of Weggel to shorten one of the signals by a first time interval for better accuracy of signals and impedance measurement".

The applicant respectfully disagrees. The applicant first points out that there is absolutely no suggestion, motivation or teaching to combine these documents. Weggel refers to power electronics while Ezenwa and applicant's invention is in the field of low current systems. Nothing in Weggel even remotely suggests introducing PWM signals into an object for complex impedance measurements. It is well-known that PWM signals would only introduce unknown higher harmonics into the object resulting in unpredicted phase errors. In fact, the harmonic content of the PWM current is not constant, but changes together with the load (the pulses will be more wide or narrow depending on the load). Any attempt to suppress some higher harmonics of the load current will interfere with the operation of the device.

Also, nothing in Ezenwa suggests, teaches or motivates introducing any other form but sine wave into the bio-object, including rectangular, including PWM signals. As explained, in fact Ezenwa makes great effort to avoid rectangular signals.

Furthermore, Weggel teaches an <u>indirect</u> method for measuring <u>a peak value of the current</u> through the load (Column 5, lines 5 to 10). Peak value of the current cannot be used for determining the electrical complex impedance without knowing the phase and amplitude of the voltage on the object at the same moment. Thus, even combining Weggel and Ezenwa would not produce the desired result.

According to the method in Weggel, PWM signal is unknown signal and the time delay is introduced into the control of switching in the measuring side. The delay is approximately equal to the switching time of the power switches Q1 and Q2, e.g., 1 microsecond (column 3, line 45). This delay is introduced with the aim to compensate the delay of the signal caused by the finite switching time of the power switches Q1 and Q2. This is just a delay, not shortening.

Second, centering and significant shortening is proposed (column 3, lines 63 to 67). This is applied to the switch control pulses in peak detectors for increasing accuracy of peak detection in the feedback loop, not for lowering the error caused by the harmonics of the carrier signal. Pulses should be as short as possible for providing accurate sampling process (saving the amplitude value into the capacitor operating as an analog memory).

The same approach also in the current measurement detector 70. As this is also accomplished as a peak detector, here the aim is to perform exact sample-and-hold procedure. The cited reference does not describe the suppression of harmonics. In fact, the harmonic content of the PWM current is not constant but changes together with load (the pulses will more wide or narrow depending on the load). Any attempt to suppress some higher harmonics of the load current interferes with the PWM device's operation.

Also, nothing in either Ezenwa or Weggel suggests modifying the rectangular signal so that it includes an interval during which the modified signal has different constant value from the constant value sections of said first modified signal. It is well known that PWM signal has modified pulse width, but only two (low and high) bipolar levels. There is no suggestion in the art to modify PWM to introduce a third signal level.

The applicant also finds that the office has mischaracterized Weggel. Weggel is not teaching "a method for measuring current through an object/load <u>by</u> pulse width modulation (PWM)", but teaches a method for measuring current through a load <u>driven by</u> PWM circuit.

The Office rejected claims 11 and 12 to 17 under 35 USC 103(a) as being unpatentable over Ezenwa and Weggel as applied to claim 10, and further in view of Eek. The Office acknowledges that "Ezenwa ad Weggel don't teach shortening signals over a first time interval to suppress the 3rd harmonic. The Office cites Eek and alleges that that reference describes a method of measuring impedance having the method step of suppressing signal harmonics interfering with accurate signals (page 2). The Office further alleges that it would have been obvious in view of Eek to select a predetermined first time interval to suppress the 3rd harmonic in order to be able to separate and identify the signal components in bioimpedance measuring in the method of Ezenwa as modified by Weggel".

The applicant respectfully disagrees. Eek does not teach the use of square wave signals for impedance measurements, but instead teaches <u>the use of a stepwise approximation of the sine wave</u> to get rid of the problem connected with the impact of higher odd harmonics to the measurement results of the synchronous demodulator. The goal is to get as close as possible stepwise approximation to the sine wave using the simplest hardware. That is, the number of approximation levels must be minimal, but still at least four (4) levels per half period as in Eek et al teach. The step levels are taken equal to the values of the sine function at the center point of the time interval of each step. The harmonic content of the stepwise approximated waveform depends only on the number of time intervals n in one cycle. In our case n=16, and the first pair of higher odd harmonics is n+/- 1), that is 15th; 17th in our case.

Eek is based on approximating the sine wave using the values of the sine wave while the applicant's modified rectangular signals have only three levels (upper, lower, and zero) and these values are independent from the values of sine function.

Even though Eek also tries to suppress higher harmonics, nothing in Eek teaches or suggests suppressing the higher harmonics by modifying the rectangular wave (claims 11 and 12). Furthermore, nothing in Eek suggests modifying both the excitation signal and the reference signal to remove different higher harmonics from different signals (claims 15 and 16).

The Office has argued as to claims 14 and 17, that "it would have been obvious in view of EEK to take the respective signals to zero during unwanted harmonics to enhance the accuracy of impedance measurement in the method of Ezenwa as modified by Weggel".

Claim 14 is dependant on claim 13 which is dependant on claim 10, and claim 17 is dependant on claim 10. At least for those reasons presented above, should be also be allowable based on the allowance of Claim 10. Furthermore, nothing in Eek teaches or suggests using a modified rectangular excitation and/or reference signal that include time intervals with zero values. On the contrary, it can be seen from Fig. 4 (page 3), that the stepwise approximation of the sine wave having 8 levels exclude zero values. Ezenwa does not even use rectangular signals to be introduced into the object and/or for driving the synchronous detector. Weggel relates to PWM signals which does not include zero value time intervals.

The Office has rejected claims 18 and 19 under 35 U.S.C. 103(a) as being unpatentable over Min(n) in view of Weggel (US 6320370). The Office acknowledges that "Min(n) doesn't

teach that the excitation and reference waves have constant values and are shortened by differing intervals for each half period to suppress harmonics", but alleges that "Weggel teaches a circuit for measuring current flowing through a load drive(n) by pulse width modulation (PWM)" and that "one having ordinary skill in the art would know that PWM involves varying the width of a train of square waves. Weggel teaches control signals taken to function as reference signals, which have pulse widths shorter than those of which are generated to drive the entire system (column 5, lines 6 – 10, claim 11). It would be obvious to one having ordinary skill in the art in view of Weggel to take the signals to values of zero during predetermined time intervals because PWM is done to eliminate harmonics which create noise and measurement error. It would have been obvious to use the signals taught by Weggel in Min(n)'s system to shorten the generated signals to accurately measure bio-impedance."

The applicant respectfully disagrees. There is no suggestion in the file to combine Min(n) and Weggel. The PWM is used in Weggel to drive the load and the PWM will depend on the load. PWM introduced into load is not for measurement purposes. The pulse width is changing and is not known. The method relates to indirectly measuring the current through the load. Nothing in Weggel suggest introducing PWM signal into an object for the purpose of measuring the impedance of the object. Furthermore, Weggel teaches determining the peak value of the current which gives no information about the electrical complex impedance. Furthermore, shortening the measurement period in Weggel is not for suppressing the unwanted harmonics, but for avoiding measurement errors due transitional currents at the time of the PWM signal switching polarity (column 3, lines 40-57).

PWM with changing pulse width introduces unknown harmonics into the system and thus, combining Min and Weggel will not produce desirable result.

At least for the reasons recited above, the applicant respectfully submits that claims 10-25, as amended, are not unpatentable under 35 USC 103. The applicant respectfully requests that the Office withdraw its rejection of these claims.

Applicant believes the above amendments and remarks to be fully responsive to the Office Action, thereby placing this application in condition for allowance. No new matter is

added. Applicant requests speedy reconsideration, and further requests that the Office contact its attorney by telephone, facsimile, or email for efficient resolution, of any remaining issues.

Respectfully submitted,

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